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**Committee on the Peaceful Uses of Outer Space**

# Twelfth meeting of the International Committee on Global Navigation Satellite Systems

**Note by the Secretariat**

## I. Introduction

### A. Background

1. The term global navigation satellite systems (GNSS) refers to all satellite navigation systems in operation or being developed around the world. Examples of such systems are the Global Positioning System (GPS) of the United States of America, the Global Navigation Satellite System (GLONASS) of the Russian Federation, Europe's Galileo system and the BeiDou Navigation Satellite System (BDS) of China. Existing GNSS constellations are constantly being augmented with new satellites. In addition, the Indian Regional Navigation Satellite System (IRNSS), also known as NavIC, provides satellite-based navigation services, and Japan is developing its Quasi-Zenith Satellite System (QZSS), which is composed mainly of satellites in quasi-zenith orbits.

2. Pursuant to the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in Vienna in 1999, the International Committee on Global Navigation Satellite Systems (ICG) was established in 2005 under the umbrella of the United Nations. It has held meetings annually: in Vienna in 2006 (A/AC.105/879); in Bangalore, India, in 2007 (A/AC.105/901); in Pasadena, United States, in 2008 (A/AC.105/928); in St. Petersburg, Russian Federation, in 2009 (A/AC.105/948); in Turin, Italy, in 2010 (A/AC.105/982); in Tokyo in 2011 (A/AC.105/1000); in Beijing in 2012 (A/AC.105/1035); in Dubai, United Arab Emirates, in 2013 (A/AC.105/1059); in Prague in 2014 (A/AC.105/1083); in Boulder, United States, in 2015 (A/AC.105/1104); and in Sochi, Russian Federation, in 2016 (A/AC.105/1134).

3. The annual meetings of ICG address GNSS science, innovative technology applications and future commercial applications. Representatives from industry, academia, Governments and providers, and users of GNSS services share views on GNSS compatibility and interoperability. ICG membership consists of members, associate members and observers. A list of the States Members of the United Nations, United Nations entities and governmental, intergovernmental and non-governmental organizations participating in ICG is contained in annex I.

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4. In compliance with its workplan, ICG organizes its work through four working groups, one focusing on systems, signals and services (co-led by the Russian Federation and the United States of America); one on enhancement of GNSS performance, new services and capabilities (co-led by China, India and the European Space Agency); one on information dissemination and capacity-building (led by the Office for Outer Space Affairs of the Secretariat); and one on reference frames, timing and applications (co-led by the International Association of Geodesy (IAG), the International Federation of Surveyors and the International GNSS Service (IGS)).

5. In the Providers' Forum of ICG, the providers of space- and ground-based navigation services conduct discussions of mutual interest focused on improving the coordination of service provision to benefit GNSS users worldwide.

6. The Office for Outer Space Affairs, as the executive secretariat of ICG and its Providers' Forum, implements a programme on GNSS applications (see A/AC.105/1159) and maintains a comprehensive information portal for ICG and users of GNSS services that is available at the Office's website: www.unoosa.org.

7. ICG held its twelfth meeting in Kyoto, Japan, from 3 to 7 December 2017. The Providers' Forum held its nineteenth meeting in conjunction with that ICG meeting, on 2 and 6 December 2017. The Cabinet Office and the Ministry of Foreign Affairs had organized the meeting on behalf of the Government of Japan.

## B. Structure and programme of the meeting

8. The programme of the twelfth meeting of ICG included three plenary meetings and a series of meetings of the four working groups. The 1st plenary meeting was held on 3 December 2017. An update was provided on satellite-based navigation systems in operation and under development, and on research and development activities for the next generation of GNSS. For each system, a representative provided an overview, described current and planned characteristics and performance, presented updates and plans and summarized ongoing interactions with other service providers. ICG members, associate members and observers representing GNSS user groups shared their views and ideas on matters of interest to ICG and its working groups.

9. An expert seminar entitled "Disaster prevention using GNSS" was held on 3 December 2017 to raise awareness of issues and opportunities relating to user applications and GNSS technology for consideration by ICG and its working groups.

10. The four ICG working groups each met separately on 4 and 5 December 2017 to review progress in implementing the recommendations made at previous meetings and look at ways and means to carry them forward in 2018 and beyond.

11. A joint meeting of the working groups was held on 5 December 2017. The working groups considered the actions to be taken on specific cross-cutting issues related to open service information-sharing and service performance monitoring. They discussed a report on the international GNSS monitoring and assessment (IGMA) task force and space service information, and a report on GNSS space service volume (SSV).

12. After considering the various items on its agenda, ICG adopted a joint statement (see sect. III below).

13. In conjunction with the twelfth meeting of ICG, the Providers' Forum held its nineteenth meeting on 2 and 6 December 2017 under the co-chairmanship of Japan and the Russian Federation (see sect. IV below).

### C. Attendance

14. Representatives of the following States participated in the twelfth meeting of ICG: China, Italy, Japan, Russian Federation, United Arab Emirates and United States. The European Union was also represented.

15. The following intergovernmental and non-governmental organizations dealing with GNSS services and applications were also represented at the meeting: Arab Institute of Navigation, Asia-Pacific Space Cooperation Organization, Civil Global Positioning System Service Interface Committee, European Space Agency, Interagency Operations Advisory Group, International Aeronautical Federation, IAG, IAG Reference Frame Sub-Commission for Europe, International Association of Institutes of Navigation and the International Federation of Surveyors. Representatives of the Office for Outer Space Affairs also attended the meeting.

16. ICG invited, at their request, observers for Australia and Pakistan to attend the twelfth meeting and to address it, as appropriate, on the understanding that it would be without prejudice to further requests of that nature and that doing so would not involve any decision of ICG concerning their status.

### D. Expert seminar on global navigation satellite systems applications

17. An expert seminar entitled "Disaster prevention using GNSS" was held on 3 December 2017 to raise awareness of issues and opportunities relating to the use of GNSS for the development of disaster risk reduction technologies for consideration by ICG and its working groups. Presentations illustrated that the monitoring of water vapour with GNSS networks was a highly accurate method for the early detection of abrupt high-impact weather events such as typhoons. Speakers demonstrated that GNSS reflectometry, a remote-sensing technique using surface-reflected GNSS signals, could improve cyclone forecasts and that expanding the earthquake and tsunami early-warning efforts globally required a plan for data streaming, a strategy for data streaming redundancy, and access to shared real-time GNSS data.

### E. Documentation

18. A list of the documents before the twelfth meeting is contained in annex II. Those documents and further information on the meeting agenda, background materials and presentations are available via the ICG information portal at the website of the Office for Outer Space Affairs: www.unoosa.org.

## II. Observations, recommendations and decisions

19. After considering the various items before it at its twelfth meeting, ICG made the observations, recommendations and decisions set out below.

20. ICG noted that the Working Group on Enhancement of GNSS Performance, New Services and Capabilities (Working Group B) finalized its booklet on SSV and submitted it to the ICG providers for consideration and endorsement prior to publication on the occasion of the fiftieth anniversary of the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE+50), in June 2018. ICG also noted that all service providers and space agencies contributed to the work of the SSV action group of Working Group B.

21. ICG noted that the sixty-first session of the Committee on the Peaceful Uses of Outer Space will include a special high-level segment dedicated to UNISPACE+50 that will offer the international community an opportunity to consider the future course of global space cooperation for the benefit of humankind.

22. ICG took note with appreciation of the reports of its four working groups, which set out the results of their deliberations in accordance with their respective workplans.

23. ICG endorsed the decisions and recommendations of the working groups with regard to the implementation of the actions set forth in their workplans.

24. ICG took note of the schedule of the working groups' intersessional meetings and workshops for 2018, which would be held in conjunction with space-related international conferences and symposiums.

25. ICG accepted the invitation extended by China to host the thirteenth meeting of ICG, in 2018, and noted the offer made by India to host the fourteenth meeting, in 2019. ICG also noted the expressions of interest by the Office for Outer Space Affairs and the United Arab Emirates in hosting the annual meetings of ICG in 2020 and 2021, respectively.

26. ICG agreed on a tentative schedule for the preparatory meetings for its thirteenth meeting, to be held during the fifty-fifth session of the Scientific and Technical Subcommittee and the sixty-first session of the Committee on the Peaceful Uses of Outer Space, both in 2018. It was noted that the Office for Outer Space Affairs, as the executive secretariat of ICG and its Providers' Forum, would assist in preparations for those meetings and the activities of the working groups.

27. At a closing ceremony, participants expressed their appreciation to the Cabinet Office and the Ministry of Foreign Affairs of Japan for organizing the meeting and to the Office for Outer Space Affairs for its work in support of ICG and its Providers' Forum, including carrying out planned activities.

## III. Joint statement

28. ICG adopted by consensus the following joint statement:

1. The twelfth meeting of the International Committee on Global Navigation Satellite Systems (ICG) was held in Kyoto, Japan, from 3 to 7 December 2017 to continue reviewing and discussing developments in global navigation satellite systems (GNSS) and to allow ICG members, associate members and observers to address recent developments in their organizations and associations with regard to GNSS services and applications. ICG also addressed disaster risk reduction and management using GNSS.

2. On behalf of Japan, the Director-General of the National Space Policy Secretariat of the Cabinet Office, the Ambassador in charge of policy planning and international security policy of the Ministry of Foreign Affairs, and the Vice-President of Kyoto University delivered opening speeches. The representative of the Office for Outer Space Affairs also addressed the meeting.

3. The meeting was organized and hosted by the Cabinet Office and the Ministry of Foreign Affairs of Japan. The meeting was attended by representatives of China, Italy, Japan, the Russian Federation, the United Arab Emirates, the United States of America and the European Union, as well as the following intergovernmental and non-governmental organizations: Arab Institute of Navigation, Asia-Pacific Space Cooperation Organization, Civil Global Positioning System Service Interface Committee, European Space Agency, Interagency Operations Advisory Group, International Aeronautical Federation, International Association of Geodesy (IAG), IAG Reference Frame Sub-Commission for Europe, International Association of Institutes of Navigation and the International Federation of Surveyors. Representatives of the Office for Outer Space Affairs also participated. Representatives of Australia and Pakistan were invited to attend as observers.

4. ICG recalled that the General Assembly, in its resolution 72/77, had noted with satisfaction the continuous progress made by ICG towards achieving compatibility and interoperability among global and regional space-based positioning, navigation and timing systems and in the promotion of the use of GNSS and their integration into national infrastructure, particularly in developing countries.

5. ICG emphasized the growing number of applications of GNSS not contemplated when the International Committee first met in 2006. Specifically, ICG noted that GNSS signals could be used for the navigation and positioning of in-orbit space operations, in particular in low-Earth and higher cis-lunar orbits. ICG requested that the Government of Japan, as host of the twelfth meeting of ICG, call to the attention of Governments participating in the second International Space Exploration Forum that GNSS was an enabling capability that could make future space exploration more efficient and safe. ICG also noted that the Forum would be hosted by the Government of Japan on 3 March 2018.

6. ICG noted that the working groups had focused on the following issues: systems, signals and services; enhancement of GNSS performance, new services and capabilities; information dissemination and capacity-building; and reference frames, timing and applications.

7. The Working Group on Systems, Signals and Services (Working Group S) completed its 2016–2017 activities under its organizational structure and workplan that were adopted, at the tenth meeting of ICG, held in Boulder, United States, in 2015. That structure included a subgroup on compatibility and spectrum protection and a subgroup on interoperability and service standards. The subgroup on compatibility and spectrum protection decided to continue addressing the need for worldwide GNSS spectrum protection through a recommendation for ICG members to encourage national regulators to protect the radio navigation satellite service spectrum from unwanted emissions. The Working Group continued its outreach and education efforts on spectrum protection by holding an expert seminar on the GNSS spectrum in Kathmandu in December 2016, in conjunction with the United Nations/Nepal workshop on the applications of GNSS. A third seminar is planned for 2018, to be held in conjunction with a United Nations/Argentina workshop on the applications of GNSS. The interference detection and mitigation (IDM) task force working under the subgroup organized and completed a sixth workshop on IDM in Baška, Croatia, in May 2017. That workshop resulted in a recommendation to work with the Third Generation Partnership Project process and organization on measures to implement crowd sourcing through mobile phones as a way to detect GNSS interference. The task force also agreed to hold a seventh workshop on IDM in conjunction with the GNSS conference to be held in Baška in May 2018.

8. The subgroup on interoperability and service standards held a meeting in Paris in July 2017, in conjunction with the 2017 International GNSS Service (IGS) workshop, to discuss follow-up work on performance standards and interoperability. The subgroup also organized a workshop held during the same week, focused on GNSS system time. The discussions at the workshop were productive, but there was a clear need for further discussions on this topic. The Working Group therefore recommended a second workshop on system time in 2018, to be coordinated with Working Group D. In 2017, the international GNSS monitoring and assessment (IGMA) task force conducted several meetings and a workshop on IGMA, held in Shanghai, China, in May. The work focused on carrying out joint trial project activity with IGS to demonstrate a global GNSS monitoring and assessment capability for a limited set of GNSS parameters. A workshop on performance standards and IGMA will be hosted by the European GNSS

Agency at the Galileo Reference Centre in Noordwijk, Netherlands, in 2018. Finally, the Working Group briefly discussed system-of-systems operations, with briefings on orbital debris mitigation for GNSS constellations. The Working Group agreed to continue these discussions, working with experts from each GNSS provider. All Working Group activities will be addressed at one or more intersessional meetings in advance of the thirteenth meeting of ICG.

9. The Working Group on the Enhancement of GNSS Performance, New Services and Capabilities (Working Group B) is progressing significantly in establishing an interoperable GNSS space service volume (SSV). Joint simulations conducted by the Working Group for multiple mission profiles provide clear evidence that, for space users at high altitude, no single constellation is able on its own to provide a sufficient level of GNSS signal availability. Exploiting the interoperability between all systems makes it possible to achieve GNSS signal availability very close to 100 per cent.

10. The work of the Working Group related to GNSS SSV and its promising outcomes demonstrated the importance and relevance of the interoperability of GNSS. The work of the Working Group also indicated very clearly the significant value of GNSS SSV for a much wider scope of future space exploration activities of various countries around the world. GNSS SSV and its potential augmentations can be seen as an enabler for many ambitious missions and activities in the context of space exploration going beyond low-Earth orbit to the Moon, Mars and other celestial bodies. The Working Group noted that new concepts, such as the deep space gateway, could use the SSV capability to serve humankind in its next phase of space exploration.

11. The excellent cooperation among all members of the SSV action team enabled it to prepare a final draft of the SSV booklet, which will be submitted to ICG for distribution to GNSS providers, so that they can review and endorse the booklet prior to its publication in time for UNISPACE+50, in June 2018.

12. Beyond the publication of the ICG SSV booklet, members of Working Group B will conduct outreach activities on an interoperable GNSS SSV and prepare conference meetings with papers and supporting illustrative video material. Future areas of work to augment an interoperable GNSS SSV have been identified. All service providers are involved in the SSV activities.

13. Search-and-rescue services are implemented by Galileo and GLONASS and will be implemented by GPS and BDS in accordance with the standards of the International Satellite System for Search and Rescue (COSPAS-SARSAT). The Working Group will continue to assess the interoperability specifications at the level of COSPAS-SARSAT in line with the Working Group's workplan. Matters of signal-level compatibility of search-and-rescue downlink signals will be followed up by the compatibility and spectrum subgroup of Working Group S.

14. A number of contributions on space weather highlighted the importance of exploiting the multitude of signals broadcast by GNSS, enabling better monitoring of space weather phenomena and progressing the understanding of the ionosphere. The large number of GNSS signals also creates interesting possibilities for scientific Earth observation utilizing reflected GNSS signals in space. The presentations showed synergies between GNSS and science. The Working Group will continue to address this topic. Furthermore, feedback has been provided on scientific experiments exploiting high-precision on-board clocks that have significantly improved the measurement accuracy of gravitational red-shift phenomena.



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15. The application subgroup of Working Group B continued its work and presented an update on the application catalogue together with an initial version of an online questionnaire to collect feedback on future user needs. The application subgroup will continue its work with the final objective of issuing a report based on the feedback collected through the online questionnaire.

16. The Working Group on Information Dissemination and Capacity-building (Working Group C) considered educational programmes and activities carried out by the Russian Space Systems company, the Moscow State University of Geodesy and Cartography, the Moscow Timiryazev Agricultural Academy, the BeiDou Belt and Road School of Beihang University, the Tokyo University of Marine Science and Technology, the University of Tokyo and the Regional Centre for Space Science and Technology Education in Asia and the Pacific, affiliated to the United Nations, to promote the use of GNSS capabilities, particularly in developing countries.

17. The Working Group emphasized that ICG should join forces with educational institutions to strengthen and deliver targeted capacity-building and technical advisory activities with the goal of sharing ideas and expertise regarding GNSS technology and its applications, particularly encouraging the participation of women and young professionals. In addition, further research on the definition of a capacity-building and workforce index should be undertaken. In order to avoid duplication of efforts in sharing available educational materials, support for an open data-sharing policy and real-time data accessibility should be taken into account.

18. The Working Group took note of the educational resources of the European Space Agency on GNSS technologies and applications, available on the wiki-based information source Navipedia (www.navipedia.net). Following a presentation given by the International Federation of Surveyors on the subcommittee on geodesy of the Committee of Experts on Global Geospatial Information Management, cooperation was considered with that subcommittee and, in particular, with its focus group on education, training and capacity-building, to assess the current availability of education, training and capacity-building resources on global geodetic infrastructure. The Working Group also took note of the GPS interference test approval process, the training activities and the authorized test exercises announced by the United States Coast Guard Navigation Center.

19. The Working Group on Reference Frames, Timing and Applications (Working Group D) noted significant progress on geodetic and timing references by GNSS providers, including: (a) the recent establishment of the subcommittee on geodesy by the Committee of Experts on Global Geospatial Information Management as part of the work under the United Nations Initiative on Global Geospatial Information Management; (b) the evaluation of the quality of the new release of the International Terrestrial Reference Frame (ITRF2014) and the significant contribution of GNSS data; (c) the refinement of the alignments of GNSS reference frames to ITRF, and (d) the information on the GNSS timing references and the comparisons of GNSS time offsets. There is a need to update some of the geodetic and timing templates.

20. The Working Group noted that the issue of sustainability of the geodetic infrastructure of globally distributed laser ranging, Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS), very-long-baseline interferometry (VLBI) and GNSS tracking stations is central to the subcommittee on geodesy. In addition to preparing a workplan to address the sustainability challenge, the subcommittee on geodesy would encourage further education and capacity-building in developing countries. Working

Group members also participated in education and outreach projects on reference frames in practice with Working Group C.

21. The Working Group continues to contribute to the IGMA initiative, in particular through its involvement in the IGMA task force/IGS joint trial project. A related issue, raised by the International Laser Ranging Service (ILRS), are the capacity constraints of the ILRS ground network in tracking all GNSS satellites fitted with laser retroreflectors. Laser tracking of GNSS satellites is an important means of independently determining the precise GNSS ephemerides, and hence evaluating the quality of GNSS satellite orbits computed by the providers and third parties using GNSS measurements and models. Guidelines on selecting which GNSS satellites will be tracked by ILRS, and for what periods and intervals, will need to be developed. The Working Group acknowledges that there has been some progress in the provision of satellite metadata by some GNSS providers. This satellite information has been shown to improve orbit modelling and accuracy.

22. The Working Group noted that some providers were providing GNSS data of their tracking stations to IGS. The Working Group will continue to monitor progress (in conjunction with the IGMA task force) in order to demonstrate the benefits of providing GNSS data from a subset of tracking stations and encourage all providers to contribute. Other issues identified by the Working Group as requiring study are the planned provision of precise positioning services by some system providers, how interoperability can be ensured through the rigorous definition of corrections and system biases, and message format.

23. The Working Group noted progress on recommendation 21, adopted at the eighth ICG meeting, held in 2013, and revised at the eleventh ICG meeting, held in 2016, on the offsets between GNSS times, but believed that closer collaboration with Working Group S would be desirable. The Working Group held a workshop on this topic in Paris in July 2017, in conjunction with the annual IGS workshop. The Working Group discussed several options that needed further concrete evaluations and updated recommendation 21.

## IV. Providers' Forum

29. The nineteenth meeting of the Providers' Forum, co-chaired by Japan and the Russian Federation, was held in conjunction with the twelfth meeting of ICG in Kyoto, Japan, on 2 and 6 December 2017. China, Japan, the Russian Federation, the United States and the European Union were represented at the meeting. In the opening remarks, the United States expressed appreciation for the work carried out by the Providers' Forum, noting that since its establishment during the second ICG meeting, in 2007, there had been significant progress and accomplishments and that the Providers' Forum continued to provide an effective multilateral mechanism for cooperation on GNSS.

30. After considering the items on its agenda, the Providers' Forum adopted the report on its nineteenth meeting, containing the discussions and recommendations set out below.

### A. Summary of discussions and recommendations

#### 1. Open service information dissemination

31. Presentations were made on the following topics.

**(a) Adjacent-band compatibility**

32. The United States presented an update on the adjacent-band compatibility study that resulted from a proposal by a United States private company made in 2011 to broadcast, in the United States, terrestrial mobile telecommunication signals adjacent to the radio-navigation satellite services (RNSS) L1 frequency band. The goal of the study was to determine the power levels that can be tolerated in the adjacent radiofrequency bands. The presentation focused on the GNSS protection criteria recommended by the United States National Space-Based Positioning, Navigation and Timing Advisory Board, including the 1 dB carrier-to-noise degradation as a GNSS receiver interference protection criterion. In order to determine appropriate interference tolerance masks at the GNSS receiver antenna input, radiated testing in an anechoic chamber was completed in 2016 using 80 civil GPS/GNSS receivers that included the following six categories: general aviation (non-certified), general location/navigation, high-precision and networks, timing, space-based, and cellular. The impact regions of a 1 dB or greater carrier-to-noise degradation that would be caused by the potential deployment of terrestrial mobile and base stations was computed for different network deployment scenarios. The results demonstrated that high-precision receivers could experience a degradation of 1 dB beyond 10 km based on macro-urban deployment with loss of lock on all GNSS satellites within 1 km of the interfering transmitter. The results highlighted that the distance from the GNSS receiver to the transmitter was a key factor, as were the transmitter density and inter-site distance associated with the network deployment.

33. The full report of the adjacent-band compatibility study will be discussed within the United States Government and will be publically available in the months following the meeting.

34. The providers emphasized that it was necessary to protect the use of GNSS, which had been one of the goals pursued by ICG. The providers also noted that the adjacent-band issue could arise not only in the L1 frequency band, as there were concerns in the European Union about potential deployments of wireless microphone applications in the band below 1,164 MHz, which could impact the L5 frequency band. Therefore, the providers agreed that it was important to follow these issues closely.

**(b) Medium Earth Orbit Search and Rescue system update**

35. The United States presented an update on the progress made with the implementation of the Medium Earth Orbit Search and Rescue (MEOSAR) system. MEOSAR implementation was currently at its initial operating capability, with 20 experimental S-band payloads and 7 operational L-band payloads. MEOSAR offered near-instantaneous beacon detection, while satellite systems in low-Earth and geosynchronous orbits could experience a delay in signal acquisition, processing, and transmission to the ground.

36. Currently there were three space-segment MEOSAR providers: GPS, Galileo, and GLONASS. The future inclusion of the BDS search-and-rescue payload into COSPAS-SARSAT was acknowledged. The next step would be to amend the terms of reference of the correspondence working group on the space segment of MEOSAR to encourage China to participate.

37. COSPAS-SARSAT acknowledged that discussions about downlinks needed to continue within the programme to ensure that beam collision was mitigated, as all four providers would need to share two downlink bands (1,544.0–1,544.2 MHz and 1,544.8–1,545.0 MHz).

38. The providers agreed to continue the discussion in ICG Working Group B and to consider specific discussions about downlinks in ICG Working Group S.

39. The European Union expressed its concerns about potential interference between MEOSAR downlinks in the 1,544–1,545 MHz band. The European Union recognized that the substantive discussion was conducted in COSPAS-SARSAT

groups, but given the urgency, it encouraged the GNSS providers, as a matter of priority, to fully engage in those technical discussions, consider all options to prevent interference, and then, in due course, report back to ICG on the progress made.

**(c) Update on space service volume**

40. The United States presented an update on the progress made in developing and utilizing a GNSS SSV and on the benefits of SSV to the domains of real-time on-board navigation, Earth sciences, launch vehicle range operations, attitude determination and time synchronization.

41. The benefits of using GNSS for real-time navigation in SSV are improved real-time navigation performance, quicker trajectory manoeuvre recovery, a reduced need for expensive on-board clocks, increased satellite autonomy and better performance for missions in highly elliptical orbit, geosynchronous orbit and beyond.

42. The speaker gave examples of GNSS being used for the positioning, navigation and timing of satellites, including meteorological satellites of Japan, the United States and the European Union, in geosynchronous and highly elliptical orbits.

43. On 13 October 2017, the National Aeronautics and Space Administration (NASA) signed a memorandum of understanding with the United States Air Force on civil SSV requirements. NASA is the United States civil space representative for the organizations that use GNSS in space and, as a result, has knowledge of the procurement, design, and production of new satellites from the perspective of SSV capabilities.

44. There is collaboration between the Interagency Operations Advisory Group and ICG to encourage service providers and others to contribute to the GNSS space user database.

45. In conclusion, SSV continues to evolve, and space missions are increasingly benefiting from SSV to improve mission performance.

46. The providers agreed that ICG should stay relevant to the wider space sector by ensuring the future contribution of GNSS to SSV. One possible way to do so was to improve GNSS system interoperability by transmitting intersystem timing offsets.

**(d) Latest progress on the International GNSS Monitoring and Assessment System**

47. China gave a presentation on progress made with the International GNSS Monitoring and Assessment System (iGMAS) and its relevance to the IGMA task force/IGS joint trial project.

48. iGMAS has been used successfully to monitor and assess constellation status, the quality of navigation signals and service performance. It has also been used to provide highly accurate multi-GNSS orbit and satellite clock products, as confirmed by comparisons with satellite laser ranging and IGS products. More information about the system is available online in Chinese and in English at www.igmas.org and through a mobile app. During the presentation, certain issues were described that related to the detailed strategy for GNSS monitoring and assessment. Discussions about the definition, methodology and output format will continue.

**(e) Application activities relating to global navigation satellite systems under the Belt and Road Initiative**

49. China also gave a presentation about the application of BDS GNSS in support of the Belt and Road Initiative.

50. In 2013, the President of China announced the Belt and Road Initiative, which was to promote global economic development. According to the presentation, the Belt and Road Initiative now covered a region of more than 60 countries, accounting for 60 per cent of the world's population and a collective gross domestic product equivalent to 33 per cent of the world's wealth.

51. BDS provided regional services and covered 30 countries included in the Belt and Road Initiative. Between 2015 and 2016, five BDS-3 testing satellites had been launched, while new technologies and concepts for BDS-3 had been validated and tested. BDS-3 would include a nominal 30-satellite constellation. The first pair of BDS-3 satellites had successfully been launched on 5 November 2017.

52. In the context of the Belt and Road Initiative, an important partner in the field of satellite navigation is the Russian Federation. Several key cooperation projects between China and the Russian Federation have been identified and launched. Joint BDS/GLONASS tests conducted in the countries covered by the Belt and Road Initiative have been fruitful. China-Europe express trains have been equipped with BDS/GPS receivers and initial operational tests and trials are currently under way. Other BDS/GNSS application cases in the countries covered by the Belt and Road Initiative include, among other things, the Pakistan national positioning network, the new Islamabad airport, activities in many countries to promote BDS applications and BDS-based precision agriculture. The presentation underlined that BDS would guarantee continuous and stable operations, with steady improvement.

53. China called on all GNSS providers to continue to work together to provide high-quality positioning, navigation and timing services to users in the countries covered by the Belt and Road Initiative and in the world as a whole.

### (f) Space weather

54. The United States highlighted the recent release by the Los Alamos National Laboratory of the United States Department of Energy of specialized space weather data collected by GPS satellites over the preceding 16 years. The data are a unique source of information that can be used to improve our understanding of space weather. They are available online (see www.lanl.gov/discover/news-release-archive/2017/January/01.30-space-weather-science.php).

### (g) Multi-global navigation satellite systems demonstration project in the Asia/Oceania region

55. Japan provided an update on the multi-GNSS demonstration project in the Asia/Oceania region. Multi-GNSS Asia (MGA) is an organization that promotes the project with 57 participating organizations from 20 countries. Since the eleventh meeting of ICG, in 2016, two MGA conferences have been held, one in Manila, from 14 to 16 November 2016, and one in Jakarta, from 9 to 11 October 2017. Events based on new formats, such as an industry seminar, a matchmaking dinner and a sponsors' exhibition, were conducted successfully. The goals for 2018 and beyond are: strengthen the user community, working towards an open innovation hub; align more closely with ICG to support the regional implementation of its recommendations; transfer secretariat responsibilities from the Japan Aerospace Exploration Agency (JAXA) to the Institute of Positioning, Navigation and Timing, Japan; strengthen the role of local partners in MGA conferences; and develop a theme-based conference and membership structure. The next MGA conference will be held in Melbourne, Australia, from 23 to 25 October 2018. MGA will be discussing possible updates to its workplan in order to enhance its linkage with ICG.

## 2. Information centres of the International Committee on Global Navigation Satellite Systems: regional centres for space science and technology education, affiliated to the United Nations

56. The ICG executive secretariat reported that a seminar on GPS data for ionospheric studies had been held at the African Regional Centre for Space Science and Technology — in French language in Rabat from 16 to 20 January 2017. Further information is available via the ICG information portal at the website of the Office for Outer Space Affairs: www.unoosa.org.

## B. Other matters

### 1. Review of Providers' Forum workplan

57. The ICG executive secretariat noted that the workplan of the Providers' Forum contained references to the "working group on compatibility and interoperability" and suggested that the workplan be updated to reflect the name change, at the tenth meeting of ICG, in 2015, to Working Group on Systems, Signals and Services. The co-chairs of the Working Group agreed to modify the workplan accordingly.

### 2. Next meeting of the Providers' Forum

58. The providers agreed to hold the twentieth meeting of the Providers' Forum in Vienna on 18 and 19 June 2018, in conjunction with UNISPACE+50.

59. The United States noted that 2017 marked the fiftieth anniversary of the entry into force, in 1967, of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

60. It was noted that the General Assembly, in its resolution 72/77, had taken note of the report of the Working Group on the Review of International Mechanisms for Cooperation in the Peaceful Exploration and Use of Outer Space of the Legal Subcommittee (A/AC.105/C.2/112). The report mentioned ICG as one of several multilateral coordination mechanisms on space issues. ICG is a successful example of such a mechanism, one dedicated to using space technologies to improve people's quality of life and stimulating economic growth globally.

# Annex I

## List of States Members of the United Nations, United Nations entities and governmental, intergovernmental and non-governmental organizations participating in the International Committee on Global Navigation Satellite Systems

China

India

Italy

Japan

Malaysia

Nigeria

Russian Federation

United Arab Emirates

United States of America

European Union

Arab Institute of Navigation

Asia-Pacific Space Cooperation Organization

Civil Global Positioning System Service Interface Committee

Committee on Space Research

European Space Agency

European Space Policy Institute

Interagency Operations Advisory Group

International Aeronautical Federation

International Association of Geodesy

International Association of Geodesy Reference Frame Sub-Commission for Europe

International Association of Institutes of Navigation

International Bureau of Weights and Measures

International Cartographic Association

International Earth Rotation and Reference Systems Service

International Federation of Surveyors

International Global Navigation Satellite System Service

International Society for Photogrammetry and Remote Sensing

International Steering Committee of the European Position Determination System

International Telecommunication Union

International Union of Radio Science

Office for Outer Space Affairs of the Secretariat

## Annex II

### Documents before the twelfth meeting of the International Committee on Global Navigation Satellite Systems

| *Symbol* | *Title or description* |
|---|---|
| ICG/WGS/2017 | Report of the Working Group on Systems, Signals and Services |
| ICG/WGB/2017 | Report of the Working Group on Enhancement of GNSS Performance, New Services and Capabilities |
| ICG/WGC/2017 | Report of the Working Group on Information Dissemination and Capacity-building |
| ICG/WGD/2017 | Report of the Working Group on Reference Frames, Timing and Applications |